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INTRA-CYCLE DYNAMICS IN A MANTIS RELIGIOSA POPULATION

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Abstract

On the basis of comparative surveys carried out on laboratory and outdoor populations of *Mantis religiosa* it is established that both the duration of development and the life span differ from the optimum in Hungary. The life span is 1,5—2 months shorter than expected in optimal conditions.

Density values are correlated with the ambient temperature. Especially spring and autumn temperature anomalies affect mortality rates.

Key words: Mantis religiosa, development, wheather conditions

Introduction

There are few publications dealing with the dynamics of preying mantid populations (e. g. BALDERRAMA and MALDONADO, 1973). The main aim of the present work is to describe the population cycle of *Mantis religiosa* in outdoor and controlled conditions, taking into account some environmental correlates.

Methods and Material

The research site is a 9 ha grassland plot at Pesterzsébet (near Budapest, Hungary) with *Festucetum rupicolae* plant association. In 1972, 200 preying mantid cocoons were experimentally introduced and monitored for 17 years. In the first generation of the studied outdoor mantid population, 88% of the viable (3 days old) individuals originated from the introduced cocoons (Table I).

Table 1. Number of resident and introduced individuals in 1972

	resident	introduced	total
N.o. of cocoons	27	200	227
N.o. of hatched ind.	3494	25 244	28 738
Ind. older than 3 days	594	4 293	4 887

The exact time of hatching and the number of hatched per cocoon was established by regular checking of marked cocoons. The number of older individuals was assessed with mark-release-recapture method (SOUTHWOOD, 1978).

Bait-stick method was used to catch mantids. Baits were living insects, usually cockroaches fixed with insect pins in dorsal position on the top of a stick higher than the herb layer.

The control population was kept in laboratory in 23 °C in the first and second larval instar and in 26 °C later. 12/12 light/dark phase was used with 2000 lux light in daytime.

Results

Components of net reproductive rate

The 17 year average of hatched individuals per cocoon is 125. Since a female lays two sets of living eggs, the average clutch size is 250. 17,2% of the young larvae could reach the age of three days, from among them about 65% were females. There are six (males) or seven (females) moultings with 12 day average time span per instar (Fig. 1, 2). The average body lengths of males and females are 5,1 and 6,5 cm respectively (Table II).

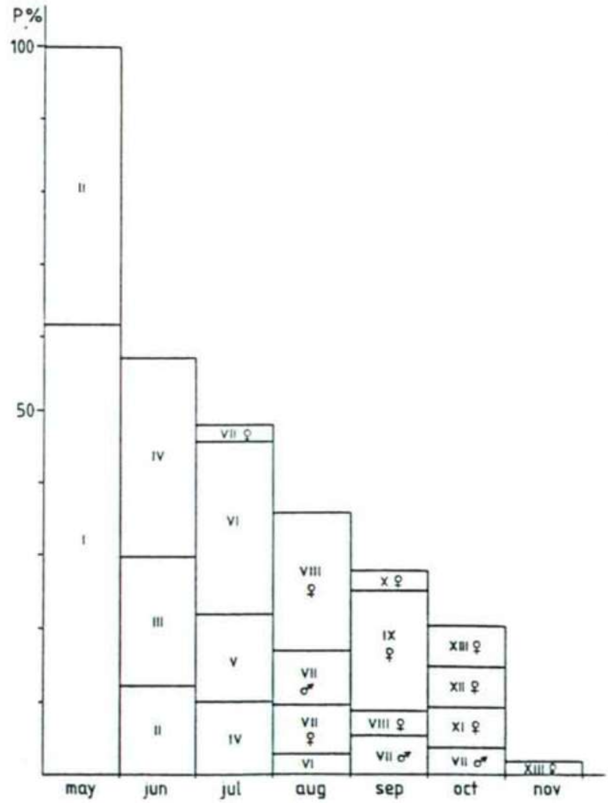

Fig. 1. 17 yr average in annual trends of the ontogenesis of preying mantid. p= frequency in percent; I—XIII developmental stages.

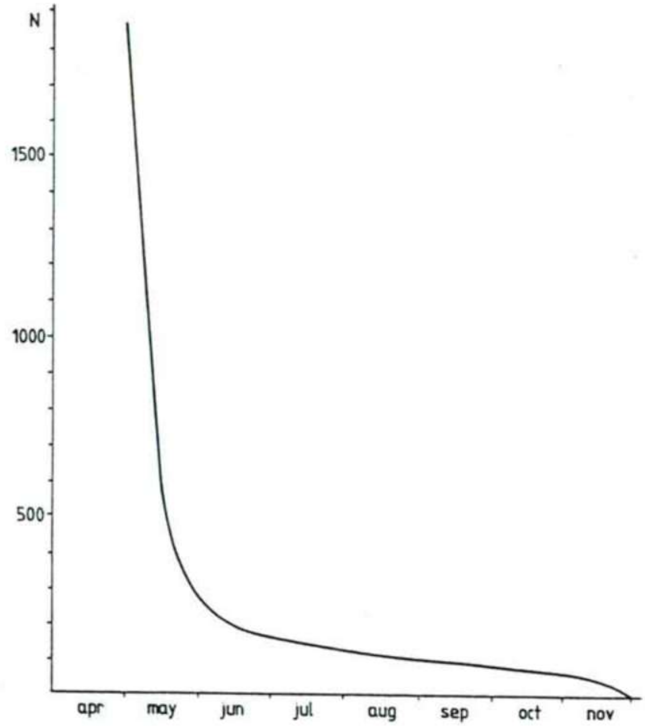

Fig. 2. Intracycle survival curve of the outdoor *Mantis* population.

Table 2. Average body size of *Mantis religiosa* in the consequtive stage of development

stage	mean body length	
after hatching	0.5 cm	
1st moulting (16 days)	0.8 cm	
2nd moulting (27 days)	1.4 cm	
3rd moulting (39 days)	2.2 cm	
4th moulting (55 days)	3.0 cm	
5th moulting (66 days)	3.9 cm	
6th moulting (75 days)	4.8 cm	(female)
6th moulting (77 days)	5.1 cm	(male)
7th moulting (86 days)	6.5 cm	(female)

In good food supply the first eggs are laid on the 11th day after the last moulting and repeating 5 times in 13 day's intervals. The two first cocoons contain viable eggs, as a rule. The average life span of females is 165 days, with a maximum of 196 days (1986). In males these figures were 110 and 176 days, respectively.

Interrelationships between ontogenesis and wheather conditions

The embryonic ontogenal stages are usually independent of climatic anomalies, because of the air compartments in the cocoons' wall, which protect against both unfavourable temperature and moisture conditions. The postembryonic developmental stages are exposed to environmetal effects as it is shown from the comparison between outdoor and laboratory populations. In captivity, under optimal environmental circumstances the average life span is 210 days (females) and 175 days (males) (Fig. 3 and 4), with 257 and 189 days' maxima.

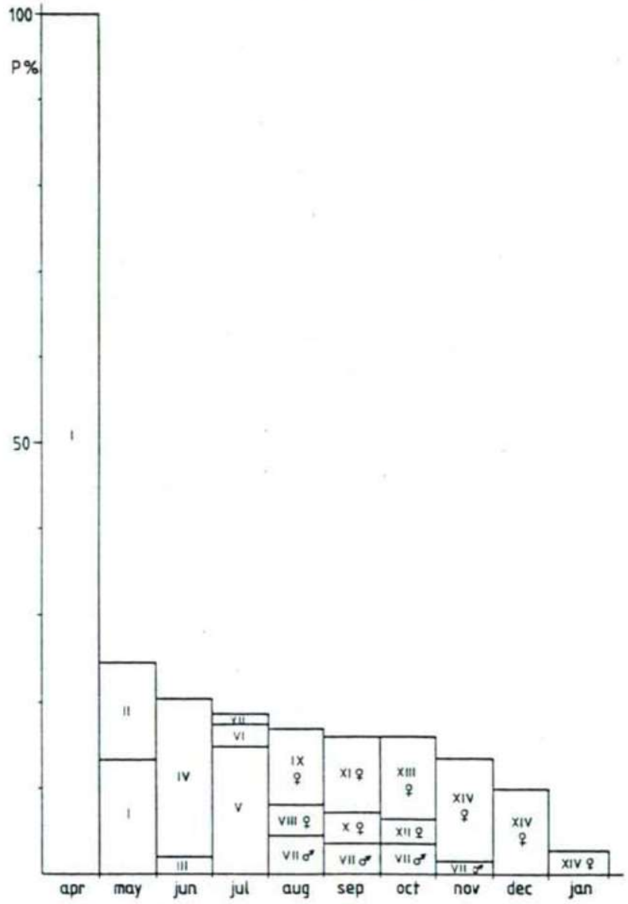

Fig. 3. Annual trends in the ontogenesis of laboratory preying mantid population.

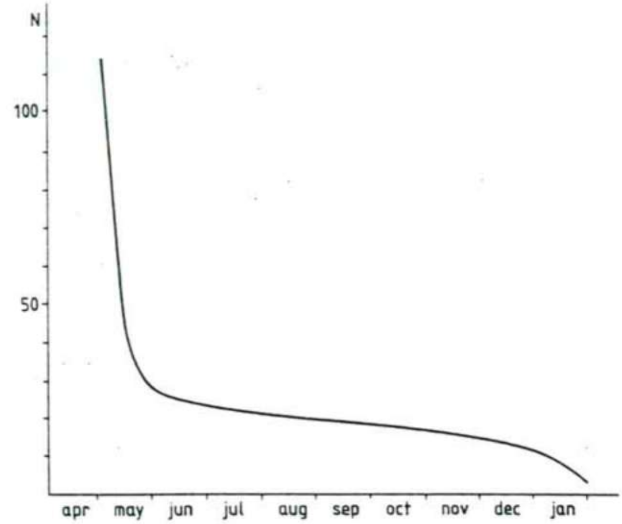

Fig. 4. Intracycle survival curve of the laboratory mantid population.

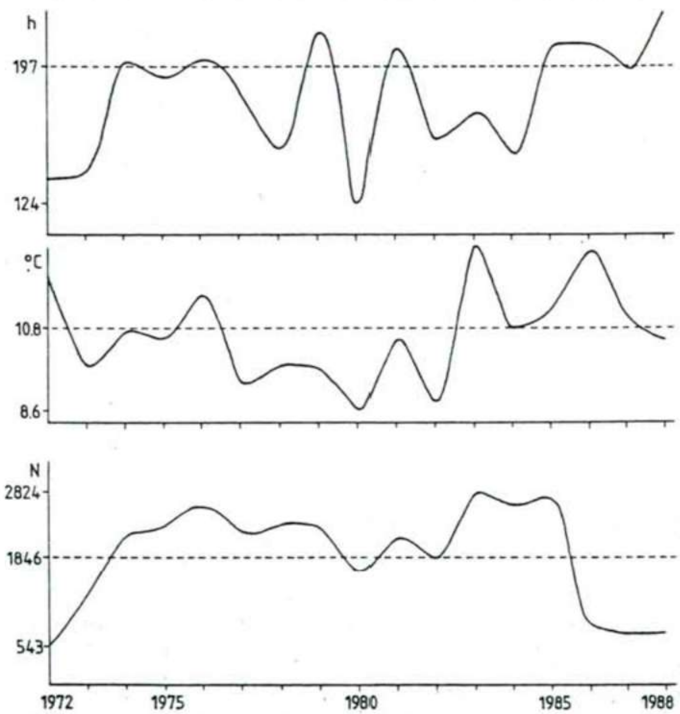

Fig. 5. Hypercyclic trends in two wheather elements (number of sunny days, h, the monthly average temperature, °C) and the number of individuals in the early stages of postembryonic development

In the outdoor population a significant relationship was found between temperature and survival in the postembryonic development (see Fig. 5). In the first years following introduction the population size was smaller than expected at the actual temperature. By 1976 this difference was totally compensated by the high hatching rates of cocoons. The cold wheather in April resulted in fewer surviving individuals in 1980 and 1982 when the temperature differed from the average with —2,2 and —2 °C respectively. The correlation was also clear in 1976 and in 1983 when the higher temperature (+0,9 and +2,2 °C above average) led to higher survival rates. In November the only mortality factor is the temperature. If the November average is below zero, the expectance of survival is negligable (as in 1983).

In the early and mid-summer, the temperature is a conditioning factor without causing mortality. The development is completed by the end of August, therefore mantids are not sensitive to moderately low temperatures in early autumn (see HIDEG, 1989 for details).

Discussion

It is clear from the results (low hatching rates and survival of the young larvae in April, high mortality values in November) that the climate in Hungary is suboptimal for mantids having a subtropical origin. Only 150 of the 2000 known mantid species live in temperate regions within the limits of 46 latitudes (GÜNTHER, 1968).

Several authors (e. g. BALDERRAMA and MALDONADO, 1973; GURNEY, 1950; SZALKAY, 1971) emphasized the high temperature demands and the wide tolerance limits to rainfall. These are in accordance with the results of the present paper.

Sphodromantis viridis, a Mediterranean mantid has similar environmental demands as *Mantis religiosa.* Its optimal temperature ranges between 25 and 30 °C. The lower developmental threshold is 17 °C and the temperature above 35 °C is also disadvantageous (KÖNIGSMANN 1963). Some mantids are inactive in mid-day to avoid high temperature (e. g. *Eremiaphila* spp., see GÜNTER, 1968).

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